DOCUMENT RESUME

ED 453 817 IR 020 701

AUTHOR Rogers, Donna M.; Swan, Karen
TITLE An Investigation of Components in Corno and Mandinach's Self-Regulated Learning Model Applied to Internet Navigation.
PUB DATE 2001-04-00
NOTE 17p.; Paper presented at the Annual Meeting of the American Educational Research Association (Seattle, WA, April 10-14, 2001).
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cluster Analysis; *Cognitive Processes; Higher Education; *Information Seeking; *Internet; *Learning Strategies; Models; *Navigation (Information Systems); Student Surveys; Tables (Data); Users (Information)
IDENTIFIERS *Self Regulation

ABSTRACT

This study examined the nature and extent of the applicability of Corno and Mandinach's (1983) self-regulation model in the new context of activities of searching the Internet. Data were collected from observations of 80 undergraduate subjects while they searched the Internet for information, as well as from survey information regarding their perceptions of their use of self-regulation strategies and processes. Cluster analysis methodology was used to isolate four independent groups of subjects, with labeling consistent with the four forms of cognitive engagement of the model (i.e., self-regulated learning, task focus, resource management, and recipient). The results provide evidence of the application of the cognitive and metacognitive strategies and processes of the Corno and Mandinach model by students while navigating the unstructured Internet. In addition, three patterns of student Internet searching emerged from the data. (Contains 12 references and 4 tables.) (MES)

# An Investigation of Components in Corno and Mandinach's Self-Regulated Learning Model Applied to Internet Navigation

By

Donna M. Rogers and Karen Swan

*As students use the Internet environment for educational purposes, there is great interest among educators and psychologists as to how students can become resourceful learners. Resourceful Internet learners are expected to be self-motivated to achieve goals. These need to be self-regulated learners. This research examines the applicability of one model of self-regulated learning to searching the Internet. It asks: Are Internet users' searching activities consistent with Corno and Mandinach's (1983) self-regulation model?*

*Corno perceives self-regulated learning differently from the traditional anticipation of achievement outcomes in specific content areas. She focuses on the processes and strategies which students use in information processing while performing academic tasks. She defines cognitive engagement as interactions of two processes, acquisition and transformation, with five embedded strategies. The forms of cognitive engagement that an individual uses while interacting with academic tasks is determined by the relative high and low applications of these two processes. Corno labels the highest level of cognitive engagement as self-regulated learning.*

*This study investigated the nature and extent of the applicability of Corno and Mandinach's (1983) model in the new context of activities of searching the Internet. Data was collected from observations of eighty undergraduate subjects while they searched the Internet for information, as well as from survey information regarding their perceptions of their use of self-regulation strategies and processes.*

*Cluster analysis methodology was used to isolate four independent groups of subjects, with labeling consistent with the four forms of cognitive engagement of the model.*

*The results provide evidence of the application of the cognitive and metacognitive strategies and processes of the Corno and Mandinach model by students while navigating the unstructured Internet. In addition, three patterns of student Internet searching emerged from the data.*

The innovative, information rich environment of the World Wide Web is a prime location to study issues of motivation, persistence, and information processing strategies. The research reported in this paper explored the applicability of a particular model of cognitive engagement in this new environment. Corno and Mandinach's (1983) model of self-regulated learning identifies cognitive strategies and processes used by students in traditional classroom settings. This study examined the use of these strategies and processes by eighty undergraduates involved in academically oriented Internet searches.

Corno (1994) defines the construct of self-regulated learning to account for an individual's active participation in goal setting and control of learning strategies and processes while involved with learning tasks. She identifies two processes acquisition and transformation, and five strategies, alerting, monitoring, selecting, connecting, and planning to describe cognitive engagement. Combinations of the high and low usage of the two processes in challenging tasks within an instructional environment determine four forms of cognitive engagement, as displayed in Table 1.

Table 1: Four forms of Cognitive Engagement from Corno & Mandinach's Model

| | | **Use of Acquisition Process** | |
|---|---|---|---|
| | | High | Low |
| Use of Transformation | High | Self-Regulated Learning | Task Focus |
| | Low | Resource Management | Recipient |

*Note:* Acquisition Process has Alerting and Monitoring as embedded strategies
Transformation Process has Selectivity, Connecting, and Planning as embedded strategies

Corno and Mandinach (1983) define self-regulation as the highest form of cognitive engagement. It is determined by relatively high usage of two processes. The other forms describing student use of processes are: task focus (low acquisition, high transformation), resource management (high acquisition, low transformation), and recipient learning (low acquisition, low transformation). The Corno and Mandinach model envisions a metacognitive relationship between the two processes, with the acquisition process metacognitively controlling the transformation process during informational processing. The processes are themselves combinations of five strategies. The acquisition process is described by the use of alerting and monitoring strategies; the transformation process is described by the use of selecting, connecting, and planning strategies. Each of the strategies can be associated with student behaviors during traditional classroom tasks.

Some of the strategies that students have learned and used during traditional classroom tasks have associated behaviors for Internet searching tasks. For example, making notes in an outline from information found in an encyclopedia is associated with those same notes from information from a webpage. Other behaviors observed during Internet searching are not present in traditional settings. For example, entering a keyword or phrase and determining the relevancy of that information to a goal is not as consistent to classroom behavior. In addition, classroom teachers may have pre-determined a set of appropriate resources as part of instructional planning, which is often not the case in Internet searches. In any case, classroom resources are inevitably very much more limited than Internet resources. Furthermore, the classroom setting

provides feedback to the student and assistance in the face of frustration while searching the Internet rarely entails instructor-generated feedback. For these and other reasons initial and sustained motivation for Internet searching may not be experienced, as experienced in the same ways as evidenced in classroom searching tasks.

Previous research specific to the Corno and Mandinach model (1983) have shown that:

- Students cognitive engagement variations can be measured during ongoing instruction (Panagiotopoulos, 1987).
- Cognitive engagement varies over time (Panagiotopoulos, 1987; Mandinach, 1984).
- Cognitive engagement varies depending on learning situations (independent vs. cooperative) and content areas (language arts vs. mathematics) (Panagiotopoulos, 1987).
- Cognitive engagement varies depending on the characteristic of the tasks, structured vs. unstructured (Howard-Rose, 1989).
- Cognitive engagement can be measured with reliability and validity by a classroom teacher's observations (Panagiotopoulos, 1987; Mandinach, 1984).
- Survey instruments can be used to determine levels of cognitive engagement (Howard-Rose, 1989).

Findings from open-ended information systems research (OEIS) have indicated that search success is affected by search experience, subject area knowledge, and prior knowledge and that time spent searching is associated with field dependency.

In order to investigate the nature and extent that Internet users display the behaviors consistent with the strategies and processes of the Corno and Mandinach (1983) model, a study was done to determine if observed behaviors and perceived use of strategies during Internet searching would define four forms of cognitive engagement consistent with the Corno and Mandinach model.

## Methodology

A sample of eighty undergraduates from an East Coast public research University was used to obtain data for the study. Participants volunteered from general studies courses to search the Internet for information on a task selected from a list of general interest topics, e.g., acid rain, Mark Twain, Olympic games. Data sources included observations of the behaviors of subjects as they searched the Internet, a metacognitive questionnaire (MQ) (Howard-Rose, 1989) for perceived classroom self-regulated learning, an Internet self-regulation survey (ISR) modified from the MQ for perceived Internet self-regulated learning, self-reported grade point average (GPA), existing knowledge, Internet search experience, and information gained from the search, and a score from the Hidden Figures Test (HFT) (ETS, 1962) for field perception. Correlations between strategies were assessed for the data from the observations, the MQ and the ISR to test for their independence.

The behaviors observed were checked from a list obtained from activities observed during a pilot study and represented the physical actions seen while subjects were searching the Internet, e.g., clicking, typing a keyword, taking notes from the screen. These were later coded into strategy level groupings according to descriptors consistent with prior research studies, and a frequency score for usage of that strategy

was obtained for each participant. A process level score was obtained by summing the frequencies of the strategies appropriate for that process for each of the participants. Cluster Analysis methodology was used to identify natural groups formed from the observational data, after standardizing the data to per-minute-usage at the strategy level for each participant. This author developed a procedure to rank strategy and process use and to identify whether those rankings were consistent with four groups defining the forms of cognitive engagement as described by Corno and Mandinach (1983). Both the process level usage scores and the strategy level usage scores were used to compare the observed behaviors with the perceived usage from the survey instruments to determine construct validity and mutually exclusive properties of strategies and processes.

Two software packages, *Minitab* (1997) and *Clustan* (1999) were employed to determine the natural groups based on a similarity rule of distance and the Complete Linking decision for combining during the agglomerative process. Results were confirmed by using the two packages. The distance between two items (single members at first and then groups) is calculated as the square root of the sum of the squared differences between the paired strategy values for the two items. For example, if item 1 has values a1, s1, c1, p1, and m1 for its strategy-use-per-minute (a=alert, s=select, c=connect, p=plan, and m=monitor) and if item 2 has values a2, s2, c2, p2, and m2, then the calculated distance is

$$D = \mathrm{Sqrt}\{ (a1-a2)^2 + (s1-s2)^2 + (c1-c2)^2 + (p1-p2)^2 + (m1-m2)^2 \}$$

The smaller the distance, the more similar the items, and each step in the agglomerative process combines those items most similar. Which items are to be

combined at every step is determined by a large grid of distances where all combinations of between-item distances are calculated.

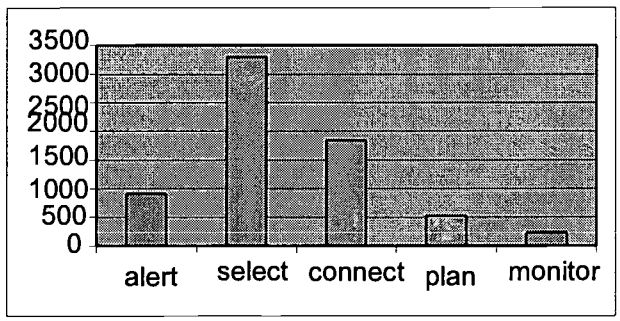
Once items have been combined, a new value must be assigned for the new group that can be used in the distance calculation. Using Complete Linking decisions requires that the distances of the two items just combined be reviewed and that the newly combined group takes the value of the larger of the two distances of its original items for the distance grid. The use of Complete Linking decisions, one of many choices, reduces the tendency toward unequal sized groups.

## Results

Over eight thousand behaviors were observed with the mean of 103 (32.9) behaviors for each individual. Wide ranges of frequencies were noted in the entire sample for the individual behaviors with seventeen behaviors having fewer than one hundred instances observed in the eighty participants. Those behaviors considered as navigation behaviors with little cognitive value (e.g., clicking on the back arrow) comprised less than 19% of the observations. Selecting was the strategy most observed in the sample data with over 3000 instances; connecting was second with nearly 2000 instances. Monitoring and planning strategies were used minimally with each being observed less than 600 times for the data set. Distances between the 80 items of the original data set ranged from .093 units (total strategy use per minute) to 2.965 units.

Table 2: Frequency of Strategies

| | |
|---|---|
| alert | 923 |
| select | 3292 |
| connect | 1840 |
| plan | 526 |
| monitor | 225 |




In the cluster Analysis of the observed behaviors, using the parameters of distance calculation and Complete Linking decisions, four natural groups were formed from the sample data. For each cluster, the software provided a profile value of each strategy that represented the mean value of the strategy-use-per-minute for that cluster. For each strategy, a ranking was completed on those values with 1 labeling the lowest value and 4 representing the highest value. There were no ties as calculations were carried to four decimal places. Since the model is defined by relatively high and low usage of processes, the strategy rankings had to be combined to a process level rank. This was done by averaging the two strategy ranks for the acquisition process, by averaging the three strategy ranks for the transformation process, and then again ranking these averages on a 1 to 4 scale, 1 being the lowest. In the sample data, this procedure determined a unique four cluster labeling of high-acquisition-high-transformation (HH), high-acquisition-low-transformation (HL), low-acquisition-high-transformation (LH), and low-acquisition-low-transformation (LL). Table 3 displays the process. These groups then define the four forms of engagement of the Corno and

Mandinach model. It is not true that all data will determine four unique groups in the ranking procedure described above.

While the clustering methodology described by Jain & Dubes (1988) and Wishart (1998) will always form any specified number of clusters, the natural clustering can be viewed as meeting some criteria, such as consistency of membership on subsets of the data and the stability of the natural breaking points on those subsets. All of the criteria suggested in the cluster analysis methodology literature were met by the sample data.

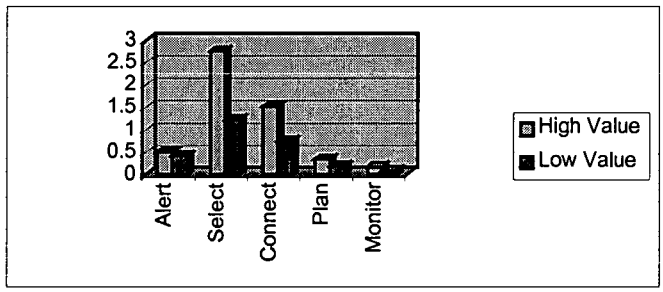
The clusters ranged in membership from 6 persons to 49 persons. Minimal chaining occurred as in the first 28 groups formed, 25 of them formed a group of 2 items, and of these two-pair groups, most ended in the LL group and were stable in those groups in the criterion for natural clustering.

Table 3: Cluster analysis forming groups labeled with Corno and Mandinach's forms of cognitive engagement. Ranking occurs in the columns. Ranks 1 = low, rank 4 = high from the data values in the parenthesis.

| Cluster | Alert Per minute | Monitor Per Minute | Sum of Acqui-sition Ranks | Average Acqui-sition Rank | Select Per Minute | Connect Per minute | Plan Per minute | Sum of Transform-ation Ranks | Average Transform-ation Rank And label | Cognitive Engagement label |
|---|---|---|---|---|---|---|---|---|---|---|
| 1<br>N=10 | 2<br>(.4293) | 1<br>(.0892) | 3 | 1.5<br>low | 2<br>(1.3478) | 4<br>(1.5196) | 2<br>(.3281) | 8 | 2.7<br>high | Low Acquisition,<br>High Transformation |
| 2<br>N=6 | 4<br>(.5049) | 4<br>(.1736) | 8 | 4<br>high | 4<br>(2.7642) | 3<br>(1.2441) | 4<br>(.3439) | 11 | 3.7<br>high | High Acquisition,<br>High Transformation |
| 3<br>N=49 | 1<br>(.4150) | 2<br>(.0989) | 3 | 1.5<br>low | 1<br>(1.2262) | 2<br>(.7470) | 1<br>(.1908) | 4 | 1.3<br>low | Low Acquisition,<br>Low Transformation |
| 4<br>N=15 | 3<br>(.4363) | 3<br>(.1233) | 6 | 3<br>high | 3<br>(2.2850) | 1<br>(.7468) | 3<br>(.3336) | 7 | 2.3<br>low | High Acquisition,<br>Low Transformation |

The profile values for the four clusters formed differed greatly, as shown in Table 4. Selecting behaviors had the greatest range of profile values between the highest and lowest ranked groups while the alerting behaviors had the smallest range between the highest and lower ranked groups.

Table 4: Frequency Differences in Strategy Values per Minute




Each of these measures, the observational data, the metacognitive questionnaire (MQ) and the Internet Self-Regulation survey (ISR) determined a different pair of dependent strategies, but consistently. Each instrument found one strategy from the acquisition process and one from the transformation process significantly related. From observations, monitoring and selecting were positively correlated; from the MQ, connecting was positively correlated with both alerting and monitoring. In the ISR, planning and monitoring were negatively correlated. Despite this seeming interdependence at the strategy level, the processes were mutually exclusive in the correlational analysis of all three instruments. The MQ and the ISR were ipsative surveys and correlations on that type of instrument are known to produce spurious results (Kerlinger, ) Conclusions are not invalidated from the dependency of the strategies as the labeling process for the forms of cognitive engagement were determined at the process level.

Several patterns of behaviors were noted among the participants. The self-regulated learners group (HH) used split screen techniques in their searching behaviors, while the task-focused group (LH) used the highest percentage of Boolean keyword and phrase entries. The two high transformation groups (HH and LH) used keywords and consistent relevancy checks, while the low transformation groups (LL and HL) used keywords and selected categories to narrow focus on the topic. The recipient learners (LL) most often chose links in a serial fashion with little contemplation of relevancy. There was also little evidence from any of the groups of progressive generation or refinement of keywords in searching, and only 22 subjects used their notes to compare with the information on the screen.

Concerning the self-reported data and its association with strategy and process use, monitoring was less likely to be observed for those with minimum search time per week and elegant search techniques were associated with maximum searching time per week. Time searching per week was also negatively correlated with perceived difficulty of task, indicating that monitoring is a learned strategy. The recipient learner group (LL) have more than the expected number of members with low Hidden Figures Test (HFT) scores, indicating that their interactions may be lower in both acquisition and transformation process usage. This same recipient learner group (LL) had proportionally lower GPA scores which may have affected vocabulary choices for keyword searches and their assessment of the relevancy of returned lists of links.

## Conclusions

In this study the Internet searchers displayed behaviors that were consistent with the strategies described in the Corno and Mandinach model. Four forms of engagement

were produced from the observations at the strategy levels, despite minimal use of monitoring and planning strategies. The lack of consistency in the identification of mutually exclusive strategies between the various instruments indicates that the perceived and observed use of strategies may differ between information processing in traditional classrooms and Internet searching. The structure of the data, however, describes the dynamic nature of self-regulated learning found previously in traditional classroom tasks. Internet searchers displayed behaviors that were consistent with the processes described in the Corno and Mandinach model. The processes were confirmed by all three instruments, indicating that the processes were more globally described and perceived by the subjects than the strategies.

Forms of individual cognitive engagement were found to vary over short sessions of Internet searching. Not everyone consistently employed the same relative level of strategy use during the sessions. Thus many of those initially in the lower acquisition levels moved higher, despite their relatively passive use of screen information, and although all five strategies were employed by persons searching the Internet, not all were seen in the same degree in every data instrument. It seems that self-regulation is a learned set of responses to academic prompts that can be applied in a new context. There also seems to be an element of motivation and ability to use the strategies. Thus students may know a strategy and not employ it (Pressley, 1995).

**Implications for Instruction and Future Research**

The implications for instructions include the need for teachers to model the use of self-regulated learning strategies, to provide scaffolding activities in Internet information processing, and to provide experience in monitoring feedback. Future research can

investigate levels of self-regulation related to time at nodes, differences in search techniques, and the variables related to preference to use multiple screens in place of Boolean search strategies. Instruments like the MQ and the ISR can be modified to a Likert-like scale to indicate the strength of preference for certain strategy use. The effects of feedback as part of the monitoring strategy can be investigated. All efforts to examine the variables that may affect the development of self-regulation will advance the understanding of an individual's sustained motivation, particularly in the context of searching the Internet.

## References


CLUSTAN®, Version 4, (1999). Clustan Associates, Edinburgh, Scotland: Lustan Ltd.

Corno, L. (1994) Student volition and education: Outcomes, influences, and practice. In Schunk, D. H. & B. J. Zimmerman (Eds.) *Self-Regulation of Learning and Performance: Issues and Educational Applications.* Hillsdale, NJ: Erlbaum.

Corno, L., & Mandinach, E. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychology, 19*(2), 88-108.

Hidden Figures Test (1962) Educational Testing Service, Princeton, NJ.

Howard-Rose, D. C. (1989). Variations in cognitive engagement as evidence of self-regulated learning (learning strategies). Unpublished dissertation, Simon Fraser University, Canada.

Jain, A. K., & Dubes, R. C. (1988). *Algorithms for Clustering Data.* Englewood Cliffs, NJ: Prentice Hall.

Kerlinger,

Mandinach, E. B. (1984). The role of strategic planning and self-regulation in learning an intellectual computer game. Unpublished dissertation, Stanford University, CA.

MINITAB® Statistical Software, Inc. (1997). State College, PA: Minitab, Inc.

Panagiotopoulos, J. (1987). Cognitive engagement variations among students and classroom tasks in one elementary classroom. Unpublished dissertation, Columbia University Teachers College, NY.

Pressley, M. (1995). More about the development of self-regulation: Complex, long-term, and thoroughly social. *Educational Psychologist, 30*(4), 207-212.

Wishart, D. (1998). *Clustan Graphics 4: Primer: A Guide to Cluster Analysis.* Edinburgh, Scotland: Clustan Ltd.

Zimmerman, B. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329-339.

**U.S. Department of Education**
*Office of Educational Research and Improvement (OERI)*
*National Library of Education (NLE)*
*Educational Resources Information Center (ERIC)*

# REPRODUCTION RELEASE

(Specific Document)

## I. DOCUMENT IDENTIFICATION:

Title: An Investigation of Components in Corno & Mandinach's Self-Regulated Learning Model Applied to Internet Navigation

Author(s): Donna Rogers and Karen Swan

Corporate Source:

Publication Date:

## II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

Level 1 ↑ [X]

Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.

The sample sticker shown below will be affixed to all Level 2A documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2A

Level 2A ↑ [ ]

Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only

The sample sticker shown below will be affixed to all Level 2B documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2B

Level 2B ↑ [ ]

Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

*I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requiras permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.*

**Sign here, → please**

Signature: Donna M Rogers
Karen Swan

Printed Name/Position/Title: DONNA M. ROGERS, ADJ. PROF
KAREN SWAN ASSOC. PROFESSOR

Organization/Address:
Karen Swan
University at Albany
2200 Washington Ave
Albany, NY 12222

Telephone: 518-442-5032

FAX:

E-Mail Address: Kswan@uamail.albany.edu

Date: 4/11/01

(over)

## III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

| |
|---|
| Publisher/Distributor: |
| Address: |
| Price: |

## IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

| |
|---|
| Name: |
| Address: |

## V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

**University of Maryland**
**ERIC Clearinghouse on Assessment and Evaluation**
**1129 Shriver Laboratory**
**College Park, MD 20742**
**Attn: Acquisitions**

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

**ERIC Processing and Reference Facility**
**1100 West Street, 2nd Floor**
**Laurel, Maryland 20707-3598**

**Telephone: 301-497-4080**
**Toll Free: 800-799-3742**
**FAX: 301-953-0263**
**e-mail: ericfac@inet.ed.gov**
**WWW: http://ericfac.piccard.csc.com**

EFF-088 (Rev. 9/97)